attract their mating partners. We have characterized the nature and the constituents of this sex pheromone-like substance, the locale of its production, its perception requirement and related sex pheromones produced by other *Caenorhabditis species*. Two candidate chemicals in the samples were defined, the exact identity of which will be confirmed by chemical synthesis coupled with bioassays. These attractants are produced by the gonad as confirmed by laser microsurgery experiments. Their activity could be abolished by mating with males. While perception of these attractants could be observed in males of the androdioecious *C. elegans*, the cellular and molecular perception pathway was delineated by repeated testing of genetic mutants affecting specific cells or molecular functions. Our results show that two different sensory neurons and an interneuron are required. Moreover, a GPCR mediated signaling pathway subjected to intracellular modulation was defined to be crucial for the pheromone perception. Hypothesis suggesting a conservation of the pheromone perception pathway across different species will be tested using chemo-attraction assay on con-specific and hetero-specific combination of testing animals. (The study was funded by Research Grant Council, Hong Kong.)

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Pax6 and Atonal expression during embryonic eye formation in the American Horseshoe crab, *Limulus polyphemus*

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The American horseshoe crab (*Limulus polyphemus*) has several sets of distinctly different eyes, including lateral compound eyes, medial ocelli, ventral and rudimentary eyes. While numerous anatomical, neurobiological and circadian studies have been conducted on these eyes, little is know about their developmental biology. A better characterization of the development of these diverse Limulus eye morphologies will enable comparisons both among these different eye types and to those of other animals. To initiate research into the developmental basis of horseshoe crab eye formation, we have isolated Limulus homologues of the Pax6 and atonal genes. Using in situ hybridization, the expression patterns of Limulus Pax6 and atonal were compared to that of MyoIII, an unconventional myosin present in all four eye types. Although all Limulus eyes contain invertebrate rhadomeric-type opsins, we were surprised to find that Pax6 and atonal expression is mainly restricted to the forming dorso-lateral sense organs. These studies will contribute to a better understanding of the evolution of eye diversity.

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Analysis of eye selector gene function in the visual system of the red flour beetle *Tribolium castaneum*

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Having retained many ancestral body plan aspects, the red flour beetle *Tribolium castaneum* is well positioned for comparative analysis of development in reference to the highly derived Drosophila. In the latter, six eye selector genes are required for the gradual determination of the adult eye primordium. Two of these, sine oculis (so) and eyes absent (eya), have been found to be also essential for larval eye development consistent with the shared evolutionary origin of insect larval and adult eyes. Strikingly, the highly conserved Pax-6 paralogs eyeless (ey) and twin of eyeless (toy) are dispensable for larval eye formation in *Drosophila*. We investigated the function of eya, so, ey and toy during larval and adult eye development in *Tribolium*. In the adult eye, systemic RNAi mediated knockdown of eya elicits complete deletion of eyes. Strong perturbation of retinal patterning is observed in so knockdown animals. Similar phenotypes are observed for larval eye development consistent with the Drosophila paradigm. Importantly, double knockdown of ey and toy leads not only to patterning defects in the adult eye but also loss of larval eyes revealing an essential requirement for larval eye development unlike in Drosophila. These data indicate that the gene network controlling larval eye development in *Tribolium* retained a more ancestral organization than that in Drosophila. Elucidating the genetic circuitry of *Tribolium* embryonic visual system development will therefore be critical for understanding of the evolution of insect eye development.

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Developmental evolution of insect metamorphosis: Transient silencing of eye selector genes in grasshopper nymphs mimics temporal dynamics of visual system development in higher insects

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The adult compound eye of primitive insects like grasshopper is the product of continuous differentiation initiated in the embryo and persisting through juvenile development. The